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CONTENTS

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Beat the Drum!

THE NEWCOMER to an industry is always in an invidious position. If he dares comment or criticise, he risks the accusation of " shooting off his head " about something of which he knows little or nothing. On the other hand, it is possible that a fresh arrival may be able to see the wood *and* the trees!

Greatly daring, therefore, we essay into the ranks with a plea of " One Industry." Has not the time arrived when the Pesticides Industry should be regarded as an entity? True, there are many sectors: the research and manufacturing: operating and distributive; engineering and packaging. Yet all, surely, come together under that umbrella which is the Pesticides Industry, an Industry growing in stature daily which, by its results, is proving wrong those who have tried to argue that the use of chemicals for control purposes is upsetting the " balance of nature."

Whether the public of this country and of the world like it or not, pesticides have come to stay. Far from remaining established at their present level, there is ample evidence there will be continuing—and rapid—expansion of the industry.

Is it surprising, therefore, that pesticides now represent a technology in their own right and that in helping improve the lot of mankind the pest technologist may be described as a public benefactor? He is helping conserve existing areas of food cultivation, to make those areas more prolific and abundant, and to develop new ones. He is assisting mankind to live a communal life and industrialise areas of the world, hitherto sparsely inhabited. In the field of health and hygiene he is aiding the reduction of epidemics by the greater control of disease-carrying insects. Indeed, life generally is the pleasanter for his activities. The development of a product for domestic spraying is again a tribute to the work of the pest technologist.

There is, too, another aspect deserving some thought: an industry is in a better position to develop and expand if it carries with it an understanding public opinion. Although there is no suggestion of other than a friendly attitude on the part of the vast majority of the public towards the products of the industry and their application to man's requirements, it is possible that at some future date new products and techniques may evoke a critical response by certain sections, and therefore an enlightened and well informed public opinion is invaluable. The concept of " One Industry " would appear to be an effective means of ensuring this.

The pest technologist is destined to play a prominent role in the future well-being of mankind. In this technological age he is one of our leading protagonists for a better, more fruitful, more habitable planet.

THE BLACK RAT AT BRITISH SEAPORTS

by COLIN MATHESON
M.A., B.Sc., F.R.E.S.

IN A PAPER published in 1939[1] an attempt was made, partly on the basis of the writer's experience at Cardiff and partly from information supplied by Medical Officers of Health in response to a questionnaire, to assess the position of the Black or Ship Rat, *Rattus rattus*, the potential carrier of bubonic plague, in some of the chief seaports in Great Britain and Ireland. In view of the continued measures for deratization on ships and on shore which have been carried on since that time, a survey of the position twenty years afterwards may not be without interest. Detailed comparison with all the data discussed in 1939 is not practicable, owing to considerable changes both in the methods of rat-destruction adopted and in the way in which the information is prepared for, and presented in, the Annual Reports of the various Medical Officers of Health; but some conclusions may be reached on the main points at issue.

Black Rats on Vessels from Abroad

Systematic work has continued on the deratting of ships arriving here from foreign countries, either by fumigation, poisoning, or trapping, or by a combination of these methods. The average number of dead rats found per vessel subjected to deratting measures varies according to the type of cargo on board, though it has gradually decreased since the years immediately before the war; but this figure is now of little significance, since the actual number of ships found to require fumigation or other measures has declined so sharply. An occasional high average figure of rats found per ship deratted in any year may be due simply to heavy infestation on a single ship, or in two or three. " However," as the Bristol Medical Officer observes in his Report for 1955, " the occurrence from time to time of these heavily infested ships stresses the need to maintain a continued and vigorous offensive against the ship rat, especially in a port such as Avonmouth where vast quantities of bagged and bulk cargoes of cereals and animal feeding stuffs are imported from countries where rodent repression, if carried out, does not appear to be very effective."

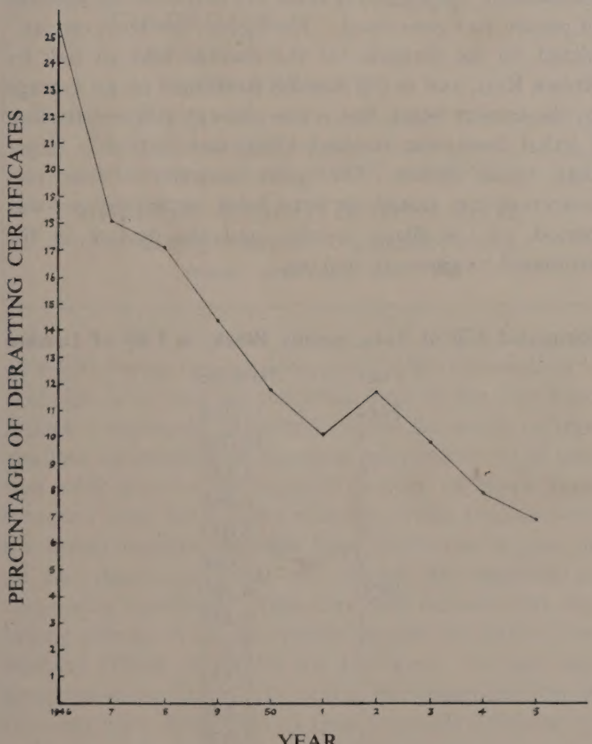
It may be mentioned that the term " heavily infested " bears a different meaning from what it did in pre-war years. The foregoing quotation referred to two ships from which 64 and 77 rats were recovered. In the nineteen-thirties, the greatest number of rats found on a single ship at Bristol varied from 234 in 1934 to 95 in 1938; and the Chief Medical Officer to the Ministry of Health, referring to the rat position on ships at British ports generally immediately after the war, commented in his Annual Report for 1946, " Fortunately the large rat populations on ships which were encountered at the close of the 1914-18 war have not been met with, and no incident has been comparable to the case of the *S.S. Khiva*, on which some 1,500 dead rats were recovered after a fumigation with sulphur candles in the Royal Albert Docks in January 1920."

More significant, as already stated, is the decrease in the number of ships requiring deratting measures. At Bristol in 1949, a total of 130 deratting exemption certificates (i.e., certifying that the ship was found to be rat-free on inspection) was issued and 18 deratting certificates (certifying that the ship was deratted at Bristol); in 1956, the number of exemption certificates had risen to 156 while the deratting certificates had decreased to 5. At Southampton, 127 exemption certificates and 16 deratting certificates were issued in 1949, as compared with 197 exemption certificates and only 3 deratting certificates in 1956. At Cardiff, during the ten years 1947 to 1956, the number of exemption certificates rose from 79% to 98% of the total certificates issued.

At the larger ports of London, Liverpool and Glasgow, where a much bigger volume of shipping from abroad is dealt with, the proportion of such shipping requiring deratting still remains higher than that quoted above, but even so the exemption certificates far outnumber the deratting certificates issued. At the Port of London in 1953, exemption certificates totalled 843 and deratting certificates 152; the corresponding figure for 1956 being 1053 (87% of the total) and 155. At Liverpool, 519 exemption and 178 deratting certificates were issued in 1949; the figures continue to show a regular increase in the exemption certificates up to 1956, when 573, or 85% of the total, were issued, as against 97 deratting certificates. In 1953 at Glasgow, 365 exemption certificates were issued as against 71 deratting certificates; by 1956 the former had risen to 433, or 93% of the total, and the latter had decreased to 34.

The Annual Reports of the Chief Medical Officer to the Ministry of Health show that for all the " approved ports " in the country (26 in 1948 and 32 in 1955) the number of deratting certificates issued declined from 725 (or 17% of the total) in the former to 337 (only 7%) in the latter year.

It seems clear therefore that the number of ships requiring deratting measures and the total number of Black Rats destroyed on board ships annually have greatly decreased; with a corresponding decrease in the chances of the Black Rat population on shore receiving any augmentation from shipping.



Decrease during the ten years 1946-1955 in the proportion of deratting certificates, expressed as percentages of the total (deratting plus deratting exemption) certificates issued annually at the "approved" ports in England and Wales.

Black Rats on Shore Premises at Docks

Liverpool—The following table shows the numbers of *Rattus rattus* known to have been accounted for, in eight pre-war and eight post-war years, on docks, quays, wharves and in warehouses and other premises at the Liverpool docks.

Black Rats destroyed on dock premises at Liverpool

Year	Black Rats	Year	Black Rats
1930	1637	1949	1591
1	1405	1950	1699
2	1968	1	2425
3	1849	2	2001
4	2479	3	1325
5	3074	4	1344
6	2870	5	1175
7	2454	6	829

There has therefore been some decrease (though not a marked one until the last year or two) in the number of Black Rats on shore at Liverpool Docks, as compared with the pre-war period.

London—At the Port of London, before the last war, no full record was kept of the numbers of each species of rat taken in docks, quays, wharves and warehouses (except in the case of rats sent for bacteriological examination); only the total number of rats of both species being recorded. From 1930 onwards however the total number of rats of both species taken on these shore premises fluctuated around an average of about 5,000 per annum,[2] ranging from 5,533 in 1935 to 4,150 in 1939. The position for eleven post-war years is given in the following table:—

Black Rats destroyed on dock premises at London

Year	Black Rats	Total (*Black and Brown*)
1946	3299	5775
7	2392	4062
8	1947	3388
9	2202	3399
1950	5148	7780
1	3220	7082
2	1625	5006
3	1327	3883
4	1462	3275
5	1045	2512
6	1123	2273

During the last two or three years therefore the numbers have diminished notably.

Bristol—At the Port of Bristol, the average number of Black Rats destroyed annually on shore premises at the docks, during the nine years 1929 to 1937 inclusive, was 1092 (ranging from 1655 in 1934 to 592 in 1937). The corresponding figure for the nine years 1948 to 1956 was only 370, with a maximum of 949 in 1949 and a minimum of 102 in 1953.

Glasgow—At the Port of Glasgow, during the nine years 1929 to 1937, the average number of Black Rats destroyed annually on shore premises at the docks was 325. The average for the nine post-war years 1948 to 1956 was 481; though the figures for the last two years showed a marked decrease, to 244 in 1955 and 166 in 1956.

Swansea—At the Port of Swansea, the average number of Black Rats destroyed on shore premises was 312 during the eight-year period 1930-37. For the eight years 1949-1956 the average was only 62, the decline having been particularly marked during the last three or four years.

Black Rats in City Premises

It has been standard practice with most Port Medical Officers, for many years, to keep records of the numbers of Black and of Brown Rats destroyed on ships, and also on docks, quays, wharves and in warehouses and other dock premises. The records of the City Medical Officers at those ports have in many cases not followed this procedure, and if any statistics are given these usually refer only to the estimated kill of " rats " or the number of " rats " recovered, irrespective of species. In a few instances, however, some information is on record, or has been supplied to me, about the Black Rat in city premises.

Liverpool—The following table shows the numbers of Black Rats recovered in the City of Liverpool, as distinct from the dock premises, for the eleven years immediately preceding and the eleven years immediately after the last war.

Black Rats destroyed in the City of Liverpool

Year	Black Rats	Year	Black Rats
1929	1946	1946	3676
1930	2060	7	2773
1	1580	8	2394
2	1100	9	2812
3	851	1950	2096
4	1129	1	2508
5	970	2	1952
6	456	3	1192
7	389	4	738
8	579	5	1909
9	612	6	1215

It appears that although the annual figures are now showing some tendency to decrease, as in the years before the war, the species has succeeded in maintaining itself in appreciable numbers within the City of Liverpool.

London—In the City of London (which is unusual in that for many years the rat population has consisted mainly of Black Rats), prior to the last war, one firm of rat-catchers of considerable repute, to which city firms were advised by Corporation officials to apply when in need of the services of a professional rat-catcher, estimated their annual destruction of rats at an average of 17,700 per annum during the nine years 1929 to 1937; after which the firm discontinued operations.

In 1943, the Corporation appointed a staff to trap rats and mice at the request of individual occupiers of city premises, the cost being reimbursed by the firms affected. Trapping was replaced in 1944 by the new and more powerful poisons which had become available, and the estimates in the following table are based on the amount of poison-bait consumed. The figures are however calculated on the formula for the average take of bait by Brown Rats, and as the amount consumed on an average by the smaller Black Rat is less (though still constituting a lethal dose), the numbers killed were probably larger than those shown. The great majority of the rats concerned are stated to have been, as in the pre-war period, of the Black species, and the decline in the estimated numbers is striking.

Estimated Kill of Rats, mainly Black, in City of London

Year	Number
1944	11,388
5	10,038
6	8,658
7	6,969
8	5,637
9	5,046
1950	4,369
1	3,436
2	2,877
3	1,527
4	1,630
5	1,070
6	782
7	902

Bristol—As regards the City of Bristol, no separate figures for Black Rats are available for the pre-war period. During the eleven years 1946 to 1956, the average number of Black Rats destroyed annually in the City was 357, with a maximum of 1,065 in 1949 and a minimum of 99 in 1953. In the Report of the Medical Officer of Health for 1946 it was stated, " The Black Rat problem caused some concern during the year, and there have been spasmodic invasions throughout parts of the city, 672 of this type being caught as compared

with 970 during the previous year." No information is available as to how far the Black Rats in the City were in fact " spasmodic invasions " from the docks or represented an established breeding population. It is true that 1949 showed the highest number of Black Rats recorded from both docks and city, while 1953 showed the lowest number recorded from both; but in view of all the factors involved this cannot be regarded as necessarily significant. One may note however the following passage from the Annual Report for 1956 of the Medical Officer of Health for Liverpool. " There was further evidence during the year of the transportation of rats and mice from time to time in goods delivered to premises. Infestation by such means would account for ship rats being found in buildings situated some distance away from the dockside wharves and also be the cause of reinfestation by rats and mice of buildings successfully cleared of rodents."

The overall position in the City of Bristol is that the numbers of Black Rats have been noticeably less since 1950 as compared with the years immediately after the war (average for 1945-50, 654 Black Rats; for 1951-56, 160).

Cardiff—At Cardiff, although the Black Rat is considered to be almost exterminated in the Port area, there is a small but persistent population in the City. In 1939 figures were given of the total number of Black Rats examined each year from the City area for the period 1928 to 1938. To these should be added the following:—1939 - 394 Black Rats examined; 1940 - 570; 1941 - 356; 1942 - 304; and 1943 - 306. From that time onwards the city rat-catcher was largely occupied with a pre-baiting and poisoning scheme in conjunction with the Ministry of Food, and little trapping was done thereafter. It is evident however that the Black Rat continued to exist in numbers until well on in the war. My records during the last three years of the above period (1941-43) show that recently-born or very young specimens constituted approximately one-fifth of the total Black Rats annually, and that they occurred in premises up to three-quarters of a mile or more from the docks.

In Research Report No. 71 of the Infestation Control Division, Ministry of Agriculture, Fisheries and Food, issued August 1957, Mr. G. R. Hill compares by means of four maps, the distribution of the Black Rat in Cardiff as shown in my 1939 paper with the position in 1951, 1954 and 1956. His maps show that the geographical distribution of Black Rats throughout the city centre has altered little during that period. The only changes are the apparent disappearance of colonies from two of the areas where they previously occurred. Odd infestations have occurred from time to time in places where they had not appeared before, but these have apparently been eliminated before they had time to establish themselves, and there has been no outward spread. Hill concludes that, despite the virtual elimination of the Black Rat from the docks and continuous treatment of premises in the city over many years, a small population of Black Rats is able to maintain itself by breeding within the city.

Glasgow—In the City of Glasgow small numbers of Black Rats occur—a total of 228 only is reported as having been found in the nine years 1948-56, most of them from premises not far distant from the docks.

Acknowledgments

My thanks are due to Dr. Powell Phillips, Medical Officer of Health for the City and Port of Cardiff, for placing at my disposal numerous Annual Reports of Medical Officers; and also to the following for supplying much information additional to that contained in their Annual Reports—Dr. J. Greenwood Wilson, Medical Officer of Health, Port and City of London; Dr. R. C. Wofinden, Medical Officer of Health, Bristol; Dr. W. A. Horne, Medical Officer of Health, Glasgow; and Dr. E. B. Meyrick, Port Medical Officer of Health, Swansea.

[1] C. Matheson, "A Survey of the Status of *Rattus rattus* and its Subspecies in the Seaports of Great Britain and Ireland," *Journal of Animal Ecology*, Vol. 8, pp. 76-93.

[2] See " Rodent Control in the Area of the Port of London Health Authority," by M. T. Morgan, J. Fisher and J. S. Watson, *The Medical Officer*, 31 July and 7 August, 1943.

THE UBIQUITOUS FURNITURE BEETLE

by

STANLEY A. RICHARDSON, *Ph.C., M.P.S., A.M.I.B.E.*

OF THE MANY insects whose activities inconvenience mankind, the humble " woodworm " seems to have acquired notoriety only within the past few decades. The growing public familiarity with wood-boring pests is no doubt due largely to advertisers who have effectively proscribed the insects as public enemies to be liquidated at all costs by this or that infallible remedy.

In the absence of such publicity it is probable that the average householder would not worry about " woodworm " any more than his grandfather did—until, that is, he became faced by a substantial bill for the replacement of decayed roof or flooring timbers. Wood-borers fail to excite the public imagination because they are seldom seen, and if seen are rarely recognised. They go to work privately, without ostentation and without great hurry, proceeding on the principle that " little strokes fell great oaks." Only the eventual, disastrous results of their operations are in any way spectacular.

Basically, wood-boring insects are scavengers. In association with various fungi theirs is the task of breaking down the cellular structure of dead wood and reducing it to dust: a highly useful function in their natural forest habitat, where decay only serves to promote new and more vigorous life. Unhappily for the householder, the insects cannot distinguish the fallen tree from timber which has been machined and worked. The female regards a crack in a rafter or joist quite as suitable for the depositing of her eggs as a splintered bough in the forest.

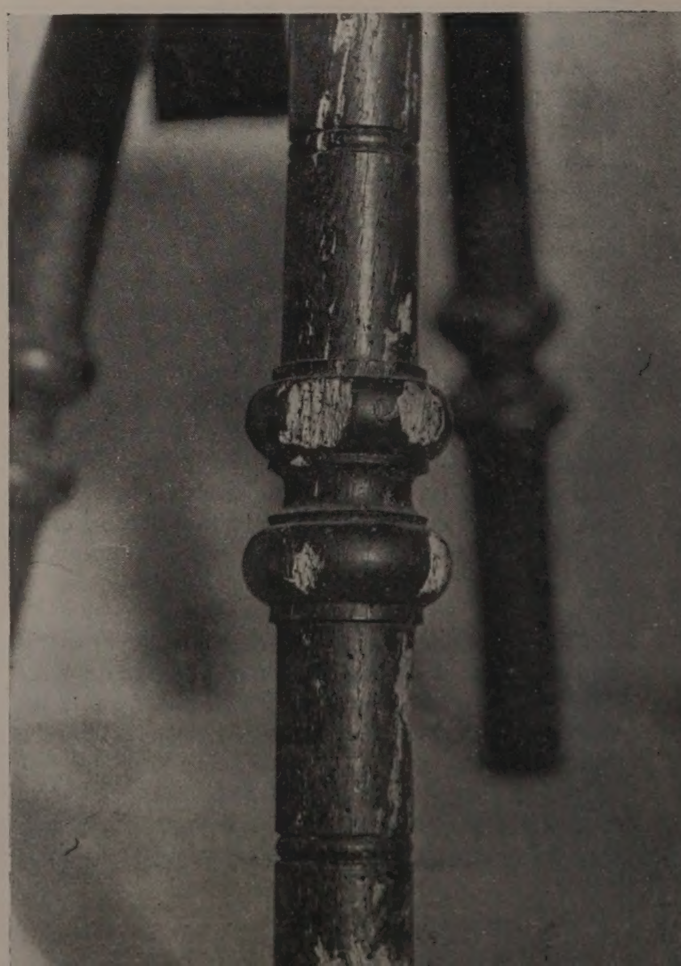
Most populous wood-borer

The term " woodworm " usually refers to the larva of the Common Furniture Beetle (*Anobium punctatum*) which is undoubtedly the most populous species of wood-borer in these islands. The Death Watch Beetle, the House Longhorn Beetle and the Lyctus Beetle each contributes a significant quota of damage—some of it very serious—but none of these insects can match the ubiquity and indiscriminating appetite of the Furniture Beetle.

The Furniture Beetle is found everywhere: from the Scillies to the Shetlands, from East Anglia to Western Ireland. Incidence of attack appears to be highest in coastal areas and river valleys, lowest in the centres of industrial towns. Few timbers can resist the attentions of the insect, and although in the majority of cases infestation is confined to the sapwood, the heartwood of timbers such as beech, birch, elm, ash and sycamore is frequently attacked. Belying its common name the larva of the Furniture Beetle is equally at home in the massive oak roof trusses of a cathedral as in the legs of a domestic chair.

Newly seasoned timber is not attractive to the Furniture Beetle, the preference being for wood which has aged somewhat. This is possibly due to long-term

Damage by Furniture Beetle to the legs of an old stool.



chemical changes in the wood or an increase in bacteria which renders the timber more suitable for nourishment of larvae. In any event, as long as twenty years may elapse between the building of a house and the first indications of beetle attack.

Infestation becomes evident with the appearance of the familiar " flight " or " exit " holes in the surface of timber, each with its little heap of clean wood dust expelled by the imago insect in the process of emerging from the wood. Such holes—roughly circular, averaging one-sixteenth inch in diameter—may appear at any time between May and September, and sometimes much earlier in the year if the spring is warm. A pinch of the bore-dust taken between thumb and finger will have a sandy " feel:" a useful means of distinguishing Furniture Beetle damage from that of other borers. Examined beneath a magnifier, the dust will be seen to contain numbers of elongated, oval pellets.

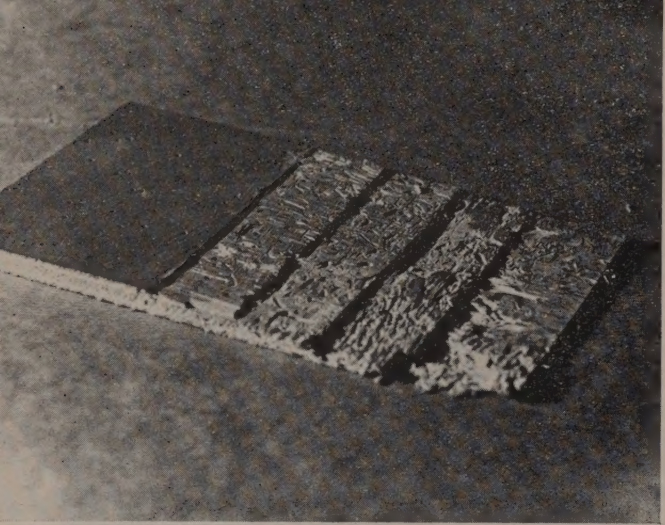
The discovery of new " flight " holes is a certain indication that the timber has been infested for at least one year and perhaps as long as three years. The holes also suggest that emerging male and female insects have paired, mated and that the female may have already deposited her fertilised eggs in suitable places.

The female abhors a smooth surface which would offer no cover to the newly hatched larvae and deny them straightforward access to their main food supply. She seeks out cracks, holes and crevices such as occur on roughly machined surfaces or at imperfect joints. The white, lemon shaped eggs are laid in tiny clutches of two, three and four, and may total as many as forty from each female. Long before the larvae hatch out in about 21 days the parents are dead, having carried the life cycle to fulfilment.

On emerging from their eggs, the larvae burrow immediately into the wood, at first following the line of least resistance along the direction of the grain. At this stage, the larvae are minute creatures, not much larger than the wood cells in which they are feeding, but growing steadily in size. Soon they are strong enough to tunnel through the denser rings of summerwood and so extend the channelling in all directions.

Rate of growth of the larvae is determined largely by the moisture content of the timber and humidity of the atmosphere. Development is slow in the absence of adequate moisture, and correspondingly rapid in damp, warm conditions. In exceptionally favourable conditions the life cycle may be completed in even less than twelve months, but the average period is one to two years.

The full-grown larva is about one-fifth of an inch in length. It ceases to burrow just below the surface of



Illustrating the damage wrought by an infestation of Furnture Beetle in plywood.(The veneers have been cut away to reveal the insect borings).

the wood and there excavates a small sealed chamber. In the course of a few weeks it changes first into a pupa and then into a beetle, which gnaws its way through the intervening layer of wood and emerges through the " flight " hole on to the surface.

Usually a dark reddish-brown in colour, the imago Furniture Beetle averages about one-sixth of an inch in length, but may be somewhat smaller if development in the larval stage has been prolonged. Under a magnifier it may be identified by the distinct rows of dark-coloured pits running longitudinally down each wing cover.

Vigorours flier

The beetle is a vigorous flier, and in infested buildings it may often be seen on the wing or crawling on walls during the " flight " season. Her power of flight enables the female beetle to deposit her eggs on timber far removed from the timber initially infested, and thus it is possible for infestation to spread not only from room to room but from building to building in the course of a few years.

Since the damage is largely limited to sapwood, the stability of large structural timbers may not be seriously affected, particularly if the wood is oak. Softwood structures, especially in damp situations, are somewhat less certain to avoid serious failure if insect attack is permitted. Elm and beech, in which the heartwood as well as the sapwood is susceptible, cannot be expected to remain structurally sound if allowed to remain infested. Flooring of sycamore or maple is likely to fail, and deal boards will often become severely riddled along the edges. That the insects can cause unsightly and sometimes dangerous damage to furniture, joinery and panelling is only too obvious.

The large sapwood content of much plywood renders this material very prone to attack, and it justly bears a poor reputation for the ease with which it becomes infested and riddled with holes. When all plywood is made fully resistant to insect attack it will be a far more valuable building material.

CONTROL

It will be understood that the effective eradication of wood-boring insects consists not only of the destruction of the larvae in the timber, but also of the treatment of the timber surface in such a way as to inhibit further depositing of eggs.

Fumigation by hydrocyanic acid gas or methyl bromide gas is sometimes resorted to and is undoubtedly effective in the destruction of larvae and pupae, but this method cannot prevent re-infestation. A similar objection applies to insecticidal smokes, which must be used monthly during the " flight " season for at least three years to free the timber from current attack.

Applications of turpentine, benzine or paraffin, such as are sometimes recommended, appear almost useless, since any insects destroyed by this method would need to be extremely near the surface to succumb to the fumes. Again, there is no barrier to re-infestation.

The ideal insecticidal preparation for application to infested timber should combine no less than three eradicating agents, ensuring (a) the release of insecticidal vapour throughout the insect borings, (b) the permeation of the timber with a stomach poison immediately fatal to the burrowing larvae, (c) the formation of a persistent insecticidal deposit both on and below the surface of the wood which prevents any further depositing of eggs and kills any emerging insects fortunate enough to escape death at the time of application. It will be appreciated that such a preparation is capable of achieving effective control with only one application, the treatment can be effective at any time of the year and that regardless of the location of the insects in the timber.

The basic principles of treatment with an insecticidal preservative such as is described above are simply that the solution must be introduced as deeply as possible into the wood and must cover every part of the unprotected exterior. In practical terms this means:

(1) All unpainted or unpolished surfaces should be thoroughly dressed with the solution. (No advantage can be gained by treating coated surfaces which no insecticide can penetrate, and which are in any event never subject to exterior attack. It may, however, be necessary in some cases to remove paint to facilitate treatment.)

(2) The solution must be forced into all holes, cracks and crevices. " Flight " holes occurring in coated surfaces should be injected.

(3) The treatment of large structural timbers may necessitate (a) the removal of surface dust, (b) the trimming away of riddled sapwood from hardwood timbers. These measures are to ensure full penetration of the insecticide and a firm, enduring surface for reception of the permanently protective deposit.

(4) Treatment should be comprehensive. Fresh " flight " holes certainly indicate current activity in their vicinity, but larvae are almost certainly working in other so far unblemished parts of the wood. The whole of an affected area must be treated if eradication is to be complete.

(5) Except in the case of small articles of furniture, the solution should be applied to timbers by means of a pneumatic type pressure spray. The nozzle should be moved slowly to and fro above the surface being treated so as to allow a gradual build-up to saturation point. In this way, the fluid will be forced deeply into the smallest apertures, ensuring that no unprotected spot remains that could be visited by an egg-bearing female insect.

The efficacy of these measures has been proved in practice over and over again during the past 23 years. Structural timber treated in 1934 shows no diminution of chemical content and is still fully proof against re-infestation by any species of borer.

Of the large number of wood-borer insecticides now available to the public, the writer is not alone in recommending one based on polychlornaphthalene. However, it must be emphasised that no matter how effective an insecticide may be, complete success can be assured only by thorough and correct application, preferably by skilled men with experience in wood-borer eradication.

A joint meeting is to be held on the 2nd October, of the Horticultural Education Association and the Association of Applied Biologists, in the Lecture Hall of the British Museum (Natural History), Cromwell Road, South Kensington, London, S.W.7, and visitors are cordially invited to attend.

The meeting will take the form of a two-session " Symposium," and the first session will be at 11 a.m. when the Chairman is to be Professor J. P. Hudson, President of the H.E.A. Afternoon session is timed to begin at 2-15 p.m. with Dr. D. J. Watson in the Chair.

In all, six papers are to be given: they are (at the morning session) " Current Views on Physiological Relationships of Root and Shoot " by Dr. L. C. Luckwill (Long Ashton Research Station), " The Roots of Fruit Plants " by Dr. W. S. Rogers and Mr. G. A. Booth (East Malling Research Station), " Root-Shoot Relationships in Fruit Trees " by Mr. H. W. B. Barlow (East Malling Research Station), (and at the afternoon session) " The Effects of various factors on the ratio of foliage to roots in Carrots " by Dr. G. S. Stanhill (National Vegetable Research Station), " The effects of the removal of part of the root system of barley on subsequent growth of Root and Shoot " by Dr. E. C. Humphries (Rothamsted Experimental Station), and " Relationship of root and shoot growth in Tomatoes " by Professor J. P. Hudson (School of Agriculture, Nottingham University).

There will be discussions at the end of the morning and afternoon sessions.

Large new warehousing facilities, as well as administration offices are being erected along the Wragby Road, Lincoln, for the old-established firm of Chisholm, Fox and Garner Limited, well-known in the pesticides' spray field.

The new premises, which will enable a large area of Lincolnshire to be serviced, are to be opened shortly.

New premises of Chisholm Fox Garner Limited, now under construction, Wragby Road, Lincoln.

TWENTY YEARS OF DDT

Geigy, the firm which discovered, developed and pioneered the use of DDT insecticides, this year celebrated the 200th anniversary of its foundation in Basle, Switzerland, in 1758

"THE NEW INSECTICIDE appeared to be so exactly what we wanted that it looked too good to be true."[1] The year was 1942: the second world war was at its height and on all fronts, east and west, there was a desperate need for a weapon to carry on the fight against disease-carrying insects. Pyrethrum was then the main standby, but the chief source of supply was closed to the west when Japan entered the war.

The "new insecticide" was DDT: its astonishing powers had been discovered in Switzerland three years earlier in 1939. As the earliest reports began to filter through screens of wartime secrecy to Britain, followed by patent specifications and samples, they seemed scarcely credible. "In England we read those patents," Professor V. B. Wigglesworth[1] wrote later, "and we were frankly sceptical. It seemed to us that too much was claimed. . . But clearly the stuff should be tested." And tested it was: a Swiss sample was tried out against one prepared in a laboratory in Manchester, and the results fully substantiated the Swiss claims. Entomologists—British and American—worked so fast discovering new ways of using DDT that "they almost came to believe that they had discovered the stuff."[1] Production processes were improved, new manufacturing plants were built, some with Government help; yet even so the military demands for DDT were so insistent that it long remained difficult to meet them, even when production was running at many tons a month.

Planned Research.

As a "war baby" DDT became famous first of all in the field of human hygiene, and its remarkable success in checking and preventing insect-borne disease and epidemics has been amply recorded in the histories of our time. In peacetime, however, we think of insecticides mainly as a means of improving and increasing food supplies, as growing crops and stored goods; and this in fact was the aim Paul Müller had in view when, working in the Geigy laboratories in Basle, he began the researches that led him, just on twenty years ago, to the discovery of DDT. The discovery, in other words, was not accidental: it was the outcome of planned research, undertaken for a definite objective. Nor did the firm which initiated the plan set out blindly on its pioneering journey. There was a logic about Geigy's progression from the manufacture of dyes and pigments to that of textile chemicals and, in particular, the moth-proofing of wool; and from there it was a natural step to the search for insecticides of more general application and to the wider field of pest control. Each of these advances was made in the light of knowledge and experience gained in the previous stage.

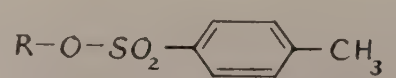
This knowledge helped the early workers to form a picture of the "perfect" insecticide, whose properties were later summed up by Müller[2] as a wide range of action; good chemical stability (to give persistence); minimum toxicity to warm-blooded animals and plants; absence of smell or other unpleasant characteristics, such as irritant action on the user; minimal "residual effect" in the sense of traces remaining in edible plants; and economy of price.

Although man has been plagued by insects since the dawn of history, his attempts to combat them were never systematic until the past half century. Some natural insecticides have a longer history: nicotine was used against aphids in the 18th century, and pyrethrum had been used against insects in Persia for centuries before it was prepared as a contact powder for that purpose in Europe in 1828. The use of rotenone, the active principle of derris, another contact insecticide, was recorded in 1848; and among organic compounds, a form of dinitro cresol was used in Germany in 1892. But this was exceptional, and in the 1920's the chief materials used in plant protection were inorganic compounds such as arsenates, fluorides, copper, mercury and sulphur in various forms. The most important of these, the arsenic compounds, are of course extremely poisonous to man and domestic animals, and it was the desire to find safer substitutes for them that gave the initial impetus to research in the organic field. Later, in the 1930's, attempts were made to synthesise pyrethrum in the United States, which at that time was using about 70% of world production, most of which came from Japan. These attempts were not successful until after the war.

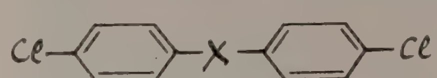
Meanwhile thousands of organic compounds were investigated for pesticidal properties, including dinitrophenols, thiocyanates, tetranitrocarbazoles and phenothiazine. Though effective in some respects, all of these failed (as did the natural insecticides) to measure up fully to the requirements listed above: either they were dangerous to use (like dinitro-o-cresol and nicotine), or they were insufficiently stable (like derris and pyrethrum); or again their range of action was too narrow.

Only in one restricted field of pest control was any notable success achieved. This was the mothproofing of textiles, where I. G. Farben (as it then was) introduced in the 1920's a range of mothproofing agents of the " colourless dye " type under the general name of Eulan. These proved highly successful in spite of certain shortcomings. By 1932 Geigy's work in the same field had reached a stage where two parallel lines were being followed, starting from two of the firm's own commercial wool dyestuffs whose chemical structures were similar to those of known mothproofs.

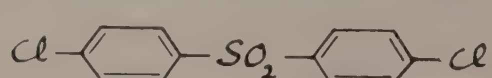
Work on one of these dyes, Eriochrome Cyanine R, led eventually, in 1939, to the discovery of the water-soluble permanent mothproof Mitin FF. The other line of research aimed at finding a solvent-soluble mothproofing substance. It started with a Polar Red dye, whose mothproofing properties were known to be due to the presence of slight traces of a toluene-p-sulphonyl phenol ester.[3]



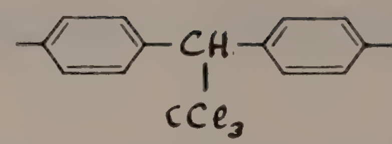
A large number of analogues were prepared to the general formula



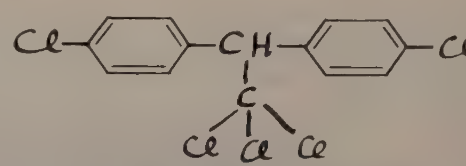
in which X may be $-SO_2-$, -SO-, -S-, -O-, $-CH_2-$, $-OSO_2-$ or $-SSO_2-$. Among these the sulphone



proved outstanding as a stomach poison; but many were found ineffective against clothes moth grubs, whose digestive system is specially adapted to deal with keratin, the main constituent of wool. Müller began testing these against other insects with a wider range of food; but he had already reached the conclusion that for various reasons a contact poison was a more effective means than a stomach poison of dealing with pests in plant protection. He found that the compound



had a powerful contact action against houseflies, and he went on to synthesise the corresponding p,p[1]-dichloro compound (dichlorodiphenyltrichloroethane) which came to be known as DDT:



This compound had indeed been synthesised in 1873 by an Austrian student, Zeidler, who did not suspect its insecticidal possibilities. To Müller belongs the credit not only for having established these but also for working out more rational methods of preparing the compound.

DDT may be described as the first synthetic contact insecticide with exceptionally good persistence and low toxicity to warm-blooded animals. It is also incidentally a stomach poison; but its value in both hygiene and plant protection lies primarily in its contact action, which it owes (in common with other contact insecticides) to its excellent "lipoid solubility." This means that it dissolves easily in fat and thus can rapidly penetrate the layer of fatty tissue in the insect cuticle. On the other hand it is practically insoluble in water (to 0.00001%) and this makes it comparatively harmless to warm-blooded organisms. Its low vapour pressure and good stability to light and oxidation give it its extraordinary persistence in action. It is in addition a comparatively simple compound, not difficult and therefore relatively cheap to manufacture.

Müller himself established the effectiveness of DDT against flies, bugs, cockroaches, mosquitoes, and Colorado beetle. Large scale field trials were carried out near Basle against the beetle which was then (1941) a serious menace to the Swiss potato crop. These and other trials confirmed the laboratory findings, and further confirmation was obtained at the Swiss Federal Research Stations at Oerlikon (for Colorado beetle) and at Wädenswil (for houseflies).

Such was the genesis of DDT, whose name has become a byword for synthetic insecticides, and which still after nearly twenty years is the insecticide most widely manufactured and used throughout the world. Its subsequent history has been told many times and need not be repeated here; however, in recent years considerable work has been done on two particular aspects of DDT, and the synthetic chlorinated hydrocarbon insecticides in general, namely toxicity and insect resistance.

This has done much to clarify the situation concerning their application and use, and is worth special mention.

By toxicity here is meant harmfulness to organisms other than those against which the use of the insecticide is directed, whether arthropod (for example bees or other beneficial insects) or warm-blooded (man or domestic animals). There is no doubt that in the first flush of enthusiasm DDT was often used indiscriminately with harmful results in certain cases. A well known example is the killing of insects which prey on the red spider mite (itself immune to DDT), so giving the latter a free run of the orchard. Because of this, and also because of its priority in time and its pre-eminence, DDT has become specially vulnerable to the general attack on synthetic pesticides as " harmful chemicals " which the public can be induced to believe are killing bees, damaging plants and generally upsetting the balance of nature. The short answer is first, that, wrongly or carelessly used, any chemical—even common salt—can be harmful and even deadly; DDT, properly used, does not injure bees or plants and is harmless to warm-blooded animals. Secondly, with a constant increase in world population, the use of pesticides is one essential means of increasing food crop yields and reducing the damage and losses caused by animal pests; and that being so, only the synthetics can, on economic and other grounds, meet the case.

Insect Resistance.

Insect resistance, by which is meant the tendency of insect communities to breed strains resistant to insecticides, is, on the long term view, a more serious question. The phenomenal success of DDT and the later introduction of other chlorinated hydrocarbon insecticides had raised the hope that the problem of insect pests had been solved for ever. But nature quickly reasserted herself. In 1956 Dr. J. R. Busvine, of the London School of Hygiene and Tropical Medicine,[4] named 24 insect species of major importance as resistant in this sense in many parts of the world; they included flies (which first showed the tendency, in Sweden, as long ago as 1946), the mosquitoes which carry malaria and yellow fever, and the lice which carry typhus. In this respect DDT is not exceptional: insects develop resistance not only to hydrocarbon insecticides but to those of other groups as well, including inorganic substances like arsenic. It is now generally accepted that resistance builds up in a confined insect community by selective action and is thus hereditary, a small number of individuals in a population being naturally able by their metabolic processes to break down the toxic ingredient of the insecticide into harmless by-products. Thus the more efficient the extermination of the susceptible members of the population the more rapid the build up of a resistant strain by the survivors.

This problem is at present being intensively studied by biological teams all over the world. They are having to go right back to fundamentals, for, in the warning words of Dr. Busvine, " it is becoming evident that to proceed with our plans, and even to hold the ground we have won, we must rethink our strategy of attack . . . " against the insect pests. This affords a very wide prospect for the future, and it is early yet to foretell just how the new strategic lines will lie. Research at present is concentrating on the way insecticides work and how insects detoxify them: radio isotopes are now being used to study the mechanism of resistance. Meanwhile much has been done on the tactical level. DDT itself, alone or compounded with other insecticides, is still enormously useful in many spheres, and where it has failed specifically the gaps have been filled by other types of substances: the organic phosphorus compounds are a notable example. The trend now seen in so many fields of applied organic chemistry—the trend towards greater specificity, implying the development of compounds " tailor-made " to carefully propounded specifications—is also evident in pesticides: it may provide an answer to the problem of sparing predacious and beneficial insects.

Certainly it means a change in the principles on which Müller and his colleagues were working twenty years ago, when they looked for something with the widest possible range of action. And they would be the last to question the need for such changes. It was their achievement to take pest control out of the realm of guesswork and put it soundly on a basis of applied science. But pest control still has to deal with nature; and nature in spite of all remains as ever changeable—and unpredictable.

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A new development for aircraft in Britain—that of crop spraying and top dressing,—has been discussed in recent months in several quarters. Here Mr. W. R. Caseby, who addressed farmers in North Lincolnshire some time ago on the subject, discusses various factors.

British Developments in Aerial Spraying

by **W. R. CASEBY.**

IT IS WELL known that for many years aeroplanes have been used in the United States and in certain other countries for crop spraying and top dressing, but only recently has this new use for aircraft been developed by British operators.

In the period from 1948 to 1955 a certain amount of experimental crop spraying and fertiliser application was undertaken by aircraft operated by British companies. Tiger Moths and helicopters were used and the principal sphere of operations was the Sudan, where spraying was required to control cotton pests and locusts. Following this work, experience was gained in Great Britain, mostly in the eastern counties, with the same types of aircraft.

Owing to the comparatively small size of fields in this country, small aeroplanes are far more economical to operate under British farm conditions than larger machines. Trials with a Bristol Freighter equipped as a high capacity fertiliser spreader were abandoned in favour of the smaller machines, usually adaptations of early types. However, the need for suitable new aircraft was apparent and two companies with experience of light aircraft production have independently produced new designs within the last two or three years. Thus Auster Aircraft Ltd. have introduced the Agricola, which can carry up to 1,680 lb. of fertiliser, or 144 gal. of spray liquid. The Edgar Percival EP.9 can transport a similar amount of material.

Intermediate aeroplane

Recently the Auster company have produced an intermediate sized aeroplane called the Workmaster, which is capable of carrying 100 gal. of spray fluid. The hundred-gallon tank on the Workmaster is placed alongside the pilot to reduce the likelihood of the tank crushing the pilot in a forced landing. The makers claim that the tank is so designed that the pilot's visibility is not impaired and that safety is enhanced by the fact that the spray load can be dumped in five seconds if a sudden emergency arises. This machine is being equipped with the Britten-Norman rotary atomiser spray gear, described below, and will be capable of spraying up to 100 acres per flight. All these machines have powerful engines, large flaps for slow, steep landing approaches and are capable of operating from short unprepared strips. Such aircraft have not yet operated very extensively in the United Kingdom, though the EP.9 was used for top dressing and spraying on a small scale in 1957.

Special equipment

Although British operators have mainly used aircraft such as Tiger Moth trainers and Auster touring machines for agricultural work, they have developed equipment for fitting to the aircraft and this is, of course, as important as the design of the aeroplane itself.

One of the earliest forms of spray attachment to an aeroplane consisted of a pipe passing along the span of the wings with nozzles spaced along its length. The liquid to be sprayed was contained in a tank and fed under pressure to the spray pipe or bar. While simple and cheap, the spray bar nozzles gave poor atomisation of the spray liquid. When a small nozzle aperture was used to improve atomisation, frequent blockages occurred. In recent years, however, two British firms, Britten-Norman Ltd., and Micron Sprayers Ltd., have collaborated to evolve a device capable of more perfect atomisation. With modern agricultural chemicals it is not necessary to drench the crop being treated with large visible quantities of spray, and Britten-Norman decided that an applicator was required for aircraft which would efficiently disperse an effective quantity of chemical concentrate per acre without the necessity of carrying a large amount of carrier, such as spray oil or water.

The outcome of their research was the Micronair rotary atomiser, which, in the author's opinion, is a considerable improvement on the rotary brush atomisers used in the United States. The use of this equipment reduces substantially the amount of diluent carried as it is designed for the concentrated spraying of ground crops, and it effectively sprays at the rate of 1 gal. per acre. Thus a Tiger Moth aircraft with a tank capacity of 45 gal. will spray up to 11 acres when fitted with a conventional spray bar and nozzle equipment, but the same aeroplane can, it is claimed, treat 45 acres, with as good results, when equipped with Micronair rotary atomisers. Commercial work, both in the U.K. and elsewhere, has shown that results from low dosage rates are as good as those obtained with normal ground spray rig equipment. Pests have been killed where no more than 0.2 gal. per acre of insecticide solution has been used.

In order to appreciate this ultra low volume spray technique three points need to be considered: droplet size; number of droplets; and strength of chemical. The volume of a droplet varies as the cube of its diameter. For example, the drop from a tap may measure about 5,000 microns in diameter. If this large drop were to be atomised into droplets of a uniform size of 500 microns, 1,000 droplets would result. At a uniform droplet size of 50 microns, one million droplets are produced. If, to be effective, a treatment requires a cover density of 500 droplets per square inch, the volume of liquid in the tap drop sprayed in droplets of 500 microns size would cover 2 sq. in. If the same amount of liquid is sprayed in droplets of 50 microns at the same cover density of 500 per sq. in., 2,000 sq. in., or one thousand times the area, can be treated. As the droplet size is reduced and the area covered increased, it is necessary to increase the insecticide concentration proportionately so that the correct dosage rate is applied.

It can therefore be seen that the question of droplet size is extremely important. The following table shows the effect of atomisation on coverage:—

Number of droplets per unit area for an application of 1 gal. per acre.

Diameter (in. microns)	*Volume (cu. microns)*	*Number per sq. mm.*	*Number per sq. in.*
10	525	1,780	1,148,100
20	4,200	222	143,190
50	65,520	14.30	9,224
100	525,000	1.78	1,164
200	4,200,000	0.22	142
300	14,175,000	0.066	43
500	....	0.014	9

The Auster Agricola agricultural aircraft. It is capable of carrying 1,680 lb. of fertiliser or 144 gal. of spray liquid.

The new Auster Workmaster, equipped with Micronair rotary atomisers, which can be seen on the wing tips.

These facts show that any substantial departure from the droplet size selected as ideal can seriously affect the efficiency of the application. If a spraying system is used which does not give reasonably precise control of droplet size it is necessary to increase very substantially the application rate to obtain effective cover. This can be wasteful in chemical and effort.

Choice of Droplet Size

The chief factors affecting choice of droplet size are the type of chemical being used, the nature of the carrier liquid, prevailing conditions, and the crop to be sprayed. The use of small droplets ensures minimum run-off of the chemical, and makes possible a dense cover without risk of leaf scorch from phytotoxic materials. Furthermore, where a small dosage rate is possible, oil may be used as the carrier instead of water; the advantages of this include easier handling, reduction in losses by evaporation and improved fixing of the chemical on the crop. On the other hand, large droplets have the advantage that there is less likelihood of drift.

As a rule it is desirable to spray oil-based chemicals in fine droplets (under 80 microns) and water-carried chemicals in larger droplets (up to 150 microns).

The principle of all rotary atomisers is that liquid fed on to a rotating disc will be thrown off the periphery in droplets of uniform size, provided that the liquid has attained the full circumferential speed of the disc. The droplet size is controlled by the speed of rotation of the disc and its diameter. Practical application of the spinning disc in agriculture is severely limited by the low rate of feed possible before slip takes place and rotary atomisation breaks down.

Multiple spinning discs and brushes have been tried, but, because of slip, commercial application with this equipment is not practicable at the rate of feed possible before rotary atomisation breaks down. The surface of the rotating cage of the Micronair atomiser maintains rotary atomisation up to a feed of several gallons per minute. Atomising capacity is a direct function of the surface area of the cylinder—a typical example being 4 in. in diameter and 14 in. long. The atomisers are driven by windmills and the blades are adjustable to give the desired r.p.m., and thus droplet size. The atomiser speed is normally between 10,000 and 15,000 r.p.m.

On a light aircraft, only two Micronair atomisers need be fitted. These are placed at the wing tips so that the spray is introduced into the wing tip vortices. This results in a wide double swathe. With a Tiger Moth operating in still air the overall width of the swathes is equal to about six wing spans, or sixty yards.

It is sometimes desirable to introduce a mist of atomised chemical into an air space, the object being to fill the maximum air space with a spray of lethal droplets. Uniform droplet size is important to ensure the largest possible number of droplets being obtained from the available spray liquid, and again the use of wing tip atomisers considerably increases the volume of air space which may be treated on each spraying pass.

Fertiliser Application

The development of equipment to spread fertilisers from aircraft in solid form has not progressed as rapidly as have spray applicators. It has been usual to fit a large hopper into the front cockpit of a Tiger Moth aeroplane or into a rear cabin of an aircraft such as the Auster Aiglet. A shutter in the bottom of the hopper allows the load to fall out into the slipstream. The principal difficulty with this method is that an uneven spread of fertiliser results. Furthermore, with most existing types of light aircraft not more than 4-5 cwt. of fertiliser can be carried. This is not a very economic load, and operators have often found themselves forced to avoid solid application and concentrate on liquid treatments.

The latest aircraft designed for agricultural work have improved types of hopper. The Auster Aiglet, for example, has a hopper gate for hydraulically controlled discharge (the capacity of the hopper is $\frac{3}{4}$ ton). The Edgar Percival Aircraft Company have likewise developed a hopper discharge outlet on their EP.9 aeroplane. Britten-Norman Limited have developed a specialised fertiliser distributor for installation in agricultural aircraft, and they state that this hopper can result in an even swathe width of 23 yd. when flying at 30 ft.

One important factor to be considered when dealing with solid fertilisers is the physical texture of the chemical itself—i.e., whether it is a dust, a powder or is granulated. A powder is difficult to discharge as it tends to block the orifice and does not flow evenly, and it is therefore necessary to agitate the chemical at the mouth of the shutter. A granulated substance, however, flows more smoothly through the gate, and has less tendency to cause a blockage; Nitra-Shell, for example, has proved completely satisfactory for aerial use, because of its even granulation. Urea is also available in granulated form, and during 1958 trials are being carried out to compare urea with Nitra-Shell when applied from the air to wheat and grassland.

The application of certain trace elements (boron, copper, manganese and zinc), nitrogen and phosphorus has been carried out on a limited commercial scale in England and Scotland, but more experimental and commercial work will be necessary before information is available to show whether or not it is an economic and effective proposition.

Other Aerial Treatments

The crop which has probably received, in the U.K., the greatest attention by aerial contractors is potatoes, because when controlling blight it is important to avoid unduly damaging the crop, and the driving of ground machines through a standing potato crop can result in a reduction in yield of up to $\frac{1}{2}$ ton per acre.

A copper-in-oil concentrate has been evolved which is suitable for aerial application by low volume spray equipment of the rotary atomiser type. It is not suitable, however, for use through typical spray gear nozzles. Each gallon of this product contains 5 lb. copper, and the rate of application is usually 1 lb. copper per acre. Suitable carrier oils can be used to give a total volume of 1.2 gal. per acre of oil and copper concentrate.

Comparative trials with Micronair rotary atomiser equipment, using the copper oil concentrate, and conventional boom rigs spraying mercurised copper oxychloride wettable powder in water, showed that the copper in oil mixture at 1.2 gal. per acre gave as effective a cover as was obtained with $3\frac{1}{2}$ lb. mercurised copper of oxychloride with 3-4 gal. water per acre. The degree of fungus control was the same in each case. This is an important point when considering the economic payload of the aeroplane and the acreage it can spray in one day. Each tank load of 45 gal. of chemical can treat approximately 37 acres, whereas when the aqueous copper oxychloride mixture is used only 15 acres can be covered with one tank load.

Trials on Orchards

The treatment of sugar beet and peas with insecticides has shown great promise, especially where an insect attack has developed in a crop which is so advanced in growth that to drive a tractor through it would cause severe damage. Aerial spraying for the control of mealy aphis of brassicas has also been carried out.

During 1957, aerial spraying trials were carried out in Britain on apple and cherry orchards, and also in a mature walnut tree plantation. The application of insecticides and fungicides to orchard trees from the air will supplement the work of ground blast sprayers travelling along beneath the trees, and should prove especially useful in orchards where the trees are encroaching on one another, and also where the trees are of considerable height.

The spraying of herbicides was practised a few years ago on large open areas of cereals and grassland, but has been discontinued because of the risk of spray drift damage.

Looking ahead, much development work has still to be done before the agricultural aerial contractor finds an established place in British farming, and experimental applications are now being carried out to compare degree of coverage and control obtained by aerial application and by ground treatment.

British Visqueen Limited have sent details of a film for package lining. One of the most chemically inert materials known, " Visqueen " offers a means of transporting corrosive or reactive materials without resorting to expensive means of packaging.

Reports from the United States are to the effect that research scientists of the United States Department of Agriculture have developed a vaccine against Newcastle disease in chickens and turkeys.

New outbreaks of myxomatosis among rabbits are reported from Yorkshire, the areas being near Pocklington and between Harrogate and Wetherby.

Better Supervision of Imported Foodstuffs?

Recently, two annual reports have been published. Both indicate the need for more adequate supervision to safeguard against infestation of certain foodstuffs.

BOLTON HEALTH COMMITTEE is to be congratulated for the sensible way in which it has pursued the subject of infestation of imported foodstuffs. Instead of prosecuting the innocent victim—the retail distributor—for something which is due to lack of adequate supervision somewhere "along the line," an approach was made by the Council to the Minister of Health, asking for the imposition of more stringent methods of control at the ports, to ensure that foodstuffs contaminated should not be allowed entry into the country.

The Medical Officer of Health for Bolton, Dr. Ronald W. Elliott, in his annual report for 1957, discussing this matter, observes that the Ministry of Health, "after a considerable delay" eventually replied to say that there might be considerable difficulties in setting up the control but that they would be writing again.

"Nevertheless," continues Dr. Elliott, "the occurrence of this infestation in human food indicates a loophole and in view of the insistence on a good standard of hygiene in premises in this country, it is regrettable that such imported foodstuffs should enter the retail market."

At the time of the report going to press—about a year from the first letter being sent to the Ministry—nothing had changed.

Since the Bolton Report was published, that of the Pest Infestation Research 1957 Department of Scientific and Industrial Research, has been issued.

The Chairman of the Pest Infestation Research Board, Professor J. B. Cragg, M.Sc., reporting to the Council for Scientific and Industrial Research, observes:—

"Taking a long view, however, it is clear that the position in relation to the infestation of our imported foodstuffs is still fundamentally unsatisfactory, since disinfestation is, in the main, only undertaken on discharge of cargoes at ports. Much damage is sustained during the voyage from the exporting countries, and, equally serious, insects spread in the holds of ships from one commodity to another, and are able to establish residual infestations in deposits of foodstuffs remaining in the holds after the cargoes have been discharged. It seems to us, therefore, that in the national interest the Laboratory must expect to become increasingly involved in infestation problems of food storage and handling in overseas territories and on board ships."

The publication of these two reports within such a short period, is an indication of the need which exists for a more adequate supervision of our imported foodstuffs.

New Pests in the North

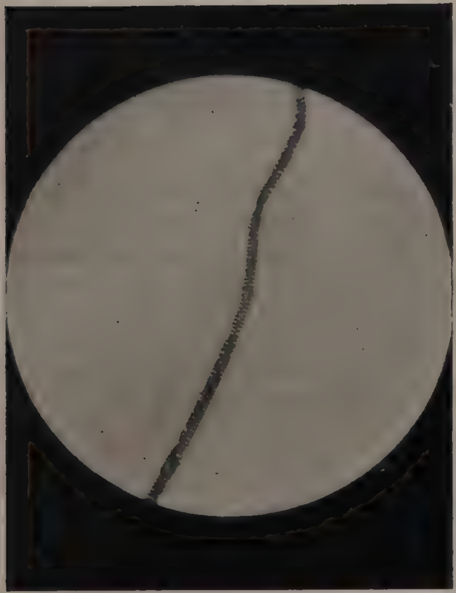
The Woolly Bear or Carpet Beetle has now invaded the north of England. This information is given by the Curator of Museums, Bolton, Mr. A. Hazelwood, writing in the annual report for 1957, of the Medical Officer of Health, Dr. Ronald W. Elliott.

A second new pest is a spider, *Heterapoda venatoria* which, Mr. Hazelwood believes, will not be long without an English name since it is so frequently imported and so hardy that it can make its home here.

It very often happens that those imported are females guarding a large circular egg-coccoon from which the young are ready to emerge by the time they reach England, hundreds at a time. Fortunately they are harmless.

"A COMMON FORM OF FOOD CONTAMINATION"

states 1957 Annual Report of Medical Officer of Health for Bolton



THE PHOTOGRAPHS are reproduced from the Annual Report of the Medical Officer of Health for Bolton (Dr. Ronald W. Elliott) and our thanks are due to him for his courtesy and co-operation in permitting reproduction.

The upper photograph is of meal mites found in tapioca and typical of insect infestation of various cereals, imported nuts and dried fruits.

The lower picture depicts rodent hair found in shelled walnuts, and is a specimen from chocolate whipped cream walnut. Walnuts are also susceptible to contamination by mites.

Declares the Report: " These contaminants are not readily visible to the naked eye—leading to difficulties for both trader and sampler. The fault in imported goods often rests overseas. Stricter import control is essential."

Magnification of each photograph is 250.

Concern has been expressed by the Bolton Health Committee at the number of imported foodstuffs found to be contaminated with insect and rodent hairs.

" Whilst it is sometimes difficult to trace the source of such infestation, much of the evidence which has become available from enquiries about the infested samples pointed to infestation on importation. For instance, a sample of rice taken on arrival at a warehouse proved to have been delivered direct from the quayside. Another difficulty arises by reason of the Warranty defence available under the Food and Drugs Act and because the Act cannot be applied extra-territorially," the Report observes.

Discussing Foreign Bodies in Food, reference is made to a meat and potato pie, the pastry of which contained a cockroach.

" There is no excuse for the presence of these insects in food premises and proceedings were taken, the manufacturer being fined £10 plus £1 costs," it is stated.

Another complaint was a meat pie which contained an insect larva. An inspection of the bakehouse revealed an infestation of various insects, a number of which were removed for identification, and some of them proved to be the same as the one found in the pie. The firm notified the Infestation Control Division of the Ministry of Agriculture, Fisheries and Food in accordance with their obligations under the Prevention of Damage by Pests Act, and a Ministry entomologist visited with the Corporation's Sampling Officer. Despite the fact that the firm had made some rapid efforts to clean out the storeroom, a further infestation was found. Proceedings were taken and in all the firm was fined £15 for selling the pie and £7 for failing to protect food.

Aerial crop-spraying by helicopters

BEA

British European Airways have available for aerial spraying of crops, a Westland S.55 helicopter, capable of spraying to a width of 80 feet, and a Bell 47, to a width of 50 feet. By combining the use of these two aircraft, fields of all sizes can be protected speedily against blight.

For details of availability and prices, please contact: Manager, British European Airways, Helicopter Unit, Gatwick Airport (South), Surrey. Telephone: LIVingstone 8833, Extn. 6723.

BRITISH EUROPEAN AIRWAYS

The Inheritance of Resistance to Insecticides in Anopheline Mosquitoes *

by G. Davidson, B.Sc.

Resistance to Insecticides is a subject of great concern to the Pesticides Industry. Here Mr. Davidson considers a particular problem.

IT HAS LONG been recognized that the ability to withstand dosages of insecticide which normally kill the species is inherent in some individuals of an insect population and that the introduction of selection by the insecticide results in the survival of these individuals which pass on this ability to their offspring. Continuing selection eventually results in the replacement of the original population by a population consisting entirely of resistant individuals. Where this has occurred in populations of malaria-carrying anopheline mosquitoes the end result has been the continuation of transmission of the disease.

Prior to 1956, the main studies on the mode of inheritance of resistance were confined to houseflies, with conflicting results. Some workers concluded that the inheritance was monofactorial, others polyfactorial and others even cytoplasmic. Milani (1956), however, in a recent re-analysis of the existing data concludes that most of these results can be interpreted as fitting a monofactorial pattern.

Since the middle of 1956 two different kinds of insecticide resistance in two different species of anopheline mosquitoes have been investigated in the Ross Institute of Tropical Hygiene in London. The first of these was a strain of *Anopheles gambiae* from Western Sokoto in Northern Nigeria, highly resistant to dieldrin (some 800 times in, fact) and cross-resistant to related compounds and to BHC, but still susceptible to DDT. Mass-matings (which are the only ones possible with mosquitoes) were made between this pure resistant strain and several susceptible strains from different parts of the same country. Hybrids were readily reared which showed an intermediate degree of resistance (some 30 times to dieldrin). When the susceptible, hybrid and resistant strains were confined on filter-papers impregnated with solutions of the insecticide of varying concentrations for a given time, using the method of Busvine and Nash (1954), it was possible to select two discriminating dosages, one killing all susceptibles but not hybrids or resistants and the other killing all hybrids (and susceptibles) but not resistants. These dosages were then used to separate the three phenotypes in the offspring of interbred hybrids, i.e. the F_2 generation, and the two phenotypes in the offspring of backcrosses between hybrids and either parent strain. The F_2 generation showed a 25% kill when exposed to the lower discriminating dosage and a 75% kill when exposed to the higher one, indicating the 1:2:1 ratio of simple Mendelian inheritance. The offspring of the backcrosses resulted in the expected 1:1 ratio of susceptibles and hybrids or hybrids and resistants depending on the parent to which the backcross was made. Dieldrin-resistance in *A. gambiae* is thus due to a single allele showing incomplete dominance.

Later in 1956 a strain of *Anopheles sundaicus* resistant to DDT (some 40 times) but susceptible to dieldrin and BHC was obtained from Java, Indonesia. This was crossed with a susceptible strain of the same species from Malaya and the resulting hybrids were found to be virtually as susceptible as the susceptible strain to DDT. In this case only one imperfect discriminating dosage was possible, namely one killing nearly all susceptibles and hybrids but very few resistants. The F_2 generation exposed to this dosage showed an approximate kill of 75%, indicating a single recessive allele for resistance. Backcrossing the hybrid with the susceptible parent produced offspring showing almost 100% kill at the discriminating dosage and with the resistant parent an approximate 50% kill at the same dosage.

These studies, then, indicate the existence of two different types of insecticide resistance in anopheline mosquitoes, both of which are monofactorially inherited:

(1) Dieldrin-BHC resistance in which three phenotypes are recognizable; these mosquitoes remain susceptible to DDT.

(2) DDT-resistance in which only two phenotypes are recognizable; these mosquitoes remain susceptible to dieldrin and BHC.

In practice this means that a change of insecticide is all that is necessary to continue mosquito control where resistance appears. This has already been done in Java and Saudi-Arabia where DDT-resistant strains of *A. stephensi* recently predominated and successful malaria control has resulted.

These studies also indicate practical means of detecting mosquito resistance in the field. The minimum insecticide dosage producing a consistent 100% mortality in a susceptible strain of the species should be first established. Fed and fertilized female mosquitoes from the area where resistance is suspected should then be exposed to this LD_{100} and offspring of survivors reared and exposed to the same dosage. If resistance is present and is of the type already determined in *A. gambiae* (to dieldrin and BHC), these offspring should show at least a 50% survival. With *A. gambiae* the hybrid shows some degree of resistance and a 50% mortality would result if the offspring were from hybrid females previously mated with susceptible males. If the parent survivors were hybrid previously mated with hybrid the offspring would show a 25% kill only, and if pure resistant the offspring would show no kill at all.

If resistance is present and is of the type already determined in *A. sundaicus* (to DDT), the offspring may show 0, 50 or 100% mortalities depending on whether the surviving female (which if resistant must be a homozygote) mated previously with a resistant, a hybrid or a susceptible male. If the latter mating took place it will be necessary to interbreed some of these offspring to obtain a second generation in which the mortality will be 75% if the resistance gene is present.

References

BUSVINE, J. R. and NASH, R., 1954, *Wld. Hlth. Org. techn. Rep. Ser.*, 80.

MILANI, R., 1956, *Riv. Parassit.*, 17: 223 and 18: 129.

* XVth International Congress of Zoology, Sect. VI, Paper 47.

The Annual Report just issued of the Medical Officer of Health for Rochdale (John Innes, M.D., D.P.H.) for the year ending 31st December, 1957, contains reference to the fact that in the report for 1957 it was mentioned that the development of bait preservatives for rats was likely to make more effective treatments possible of the main sewers.

The effect of using these bait preservatives was twofold. " Their use permits the placing of larger baits in the manholes and allows a greater interval before the poison bait is placed. Thus, the method is more effective in promoting amongst rats the habit of feeding at the manhole. Secondly, the use of bait preservative makes a more flexible programme possible," it is observed.

The approach to pesticides

by

E. F. EDSON, O.B.E., M.Sc., M.B., Ch.B.

"If only users would always read and follow our instructions" . . . .

AGRICULTURAL CHEMICALS — that means insecticides, weedkillers, fungicides and the like—rely for their effectiveness on being able to kill or control the pest, without significant harm to the crop, or other "wanted" things such as humans, farm stock, game, wild life, bees, fish. Sometimes the chemical itself has a very high selective toxicity for the pest species; for example, the copper fungicides have far greater capacity for killing fungi and algae (green slimes in water) than for injuring other species of life. Similarly the widely-used hormone weedkillers for use on lawns, or in cereals, present infinitely less risk to living animals than to living plants. DDT is highly toxic to insects, but not to humans or farm stock. Usually, a chemical's selectivity is only partial and has to be increased by making sure that it is only put in the right place at the right time, to give least chance of ill-effects on the "wanted" species. The main trouble is that there is just not enough scientific knowledge available, either in making pesticides or in making the medicinal chemical used by doctors to synthesise substances which will only kill pests.

Every chemical manufacturer trying to produce better pesticides knows to his cost that for every worthwhile new compound, hundreds of possible compounds will have been made, and rejected as either useless, too temperamental, too expensive or too poisonous to man, animals or birds. Manufacturers also realise that injudicious decisions or lack of care could lead them to market a chemical which was really far too dangerous to be safely handled by farm workers. All the bigger manufacturers therefore make sure that right from the start of a new chemical's history, the safety aspects of its use are kept in mind. Thus, studies are carried out on its toxic properties, just as thoroughly, and just as urgently, as if it was a new drug to be used in medicine.

The first step is usually that a small sample of the chemist's first efforts is forwarded for initial "toxicity tests." From tests with a few animals, mainly rats, it soon becomes clear whether the new chemical can be continued with or must be thrown out because it is "too hot to handle". If it does seem safely usable, then more of it is prepared, and a deliberate attempt made, during several weeks or months work in the experimental laboratory, to find out all its worst properties. This is likely to mean much more detailed tests on rats, and some critical tests on several other species of animals and birds too, rabbit, mouse, guinea pig, hamster, hen, duck and even pheasants. Other tests measure its risks when small doses are given daily, to see if any toxic effects arise eventually. Tests are also made on its ability to pass through the skin, and to cause poisoning by external contamination, such as may happen when splashes of toxic chemical on the hands are not washed off.

When the new compound's technical effectiveness seems fairly certain, and when it is felt certain to be stable, reliable, and free from other properties undesirable to the purchaser and grower, the proper "full scale toxicity test" is begun. All the previous tests are now repeated, using more animals. More critical tests are carried out; studies are made on the diagnosis and treatment of accidental poisoning, and what happens to the chemical in the body; tests are made to see if recovery from poisoning is swift and complete, or lingering and incomplete; and the properties of the particular formulation which the grower will use are also studied. If it is a chemical to be used on food crops, it will be almost essential to do far more work than if it is used only on non-food crops because we are all food consumers. A method will have to be worked out by the chemists so that traces of the chemical on harvested crops can be detected and measured. Greenhouse, trial plot and field tests will have to be made to see how long it takes for the chemical to "weather" from all the treated crops. Parallel with these chemical studies, very arduous tests

must be begun, and continue for anything from three to twelve months, in which large groups of rats and other species receive the chemical in their powdered meal diet, day after day. Observations on the normality or abnormality of weight gain, behaviour, food consumption and the biochemistry of the animals eventually show what amount of the chemical can be taken by rats daily without harm—the " no effect " level. It is then sometimes possible to do direct tests on human volunteers, usually from the manufacturer's own staff, so that the main points of safety suggested by animal experiments can be confirmed before growers receive the material. This extensive series of chemical and toxicological results are now submitted to the Government's experts—the "Inter-Departmental Advisory Committee on Poisonous Substances for Use in Agriculture and Food Storage." If the material is considered safe for use, the manufacturer may go ahead with his plans. If it is considered in any degree dangerous, proportional safety requirements are devised. For example, the product may be included with those for which, by law, the employer must provide, and employee adopt, safety measures. The manufacturer may have to include on his sales literature and labels such instructions as " Do not apply within (x) days of harvesting " or even " Do not use on food crops."

Thus, by the time a grower sees a new pesticidal chemical, it will have already been in some existence, and under careful, expensive study for two, three or more years. The safety precautions on its label will have been carefully worked out by the manufacturers, in liaison with the Government, from the results of scores of scientific experiments. If the chemical is extremely effective, and therefore takes a specially valuable place in the growers' list of good chemicals, the manufacturer may have decided to market it despite the fact that it may, if misused, present some real risks to careless workers, to stock etc. Every manufacturer therefore utters the same frequent plea—"if only users would always read and follow our instructions." Most growers do—but the occasional ones who fail to complete the manufacturer's work, by themselves being careless, are likely to run risks or to cause risks to others. No matter how carefully risks are investigated by toxicologists in the pesticide industry, no amount of investigation will make a chemical less toxic than it is. We measure the risks carefully, tell growers what they are, and advise them on how to avoid risks. When the growers have that information, the rest is clearly up to them.

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NEWS OF THE INDUSTRY

Mr. N. R. Minden

Mr. N. R. Minden joined the Standardised Disinfectants Co., Ltd., on the 1st September, 1958, as Agricultural Sales Manager.

Mr. Minden has been in the agricultural chemical industry since 1946 and has worked with leading chemical companies in both home and export markets. In his new position he will be responsible for developing sales of SDC insecticides and fungicides and particularly the Company's new range of "Stancide" selective and total weedkillers. The Standardised Disinfectants Company offer a special service to agricultural spray contractors.

Mr. D. S. Downey, N.D.A., N.D.D., at present Assistant County Agricultural Officer (Advisory) for Denbighshire, has been appointed County Advisory Officer for Cardiganshire. He will succeed Mr. A. D. Thomas, B.Sc., F.R.I.C.S., who is retiring from the Public Service.

Mr. J. B. Kerr, B.Sc., at present Assistant County Agricultural Officer (Advisory) for Northumberland has been appointed County Advisory Officer for Northamptonshire from the 8th September, 1958. He succeeds Mr. L. J. McHardy, M.Sc., N.D.A., who was transferred as County Advisory Officer to Dorset on the 7th July, 1958.

Hops Helicopter

Spraying hop gardens in Kent made an interesting news film on the 3rd September last, when the B.B.C. South East England News, featured this, the script entitled " Hops Helicopter " was as follows:

" Hop-Picking has already begun in a number of areas, but some of the hops have been attacked by the fungus disease, known as downy mildew. To prevent its spreading, the growers must spray, and this year a new method is being used: the helicopter. It's loaded with a copper solution. The exceptionally wet weather has been a direct cause of the downy mildew, and the helicopter has been called in largely because the gardens are too wet for tractor-towed spraying machines to be used. Also, just before picking, the hop vines are so thick it's difficult to reach the top with a ground spray. The helicopter has another advantage: a 40-acre plot which would be a full week's work for one man with a tractor-drawn spray can be dealt with in about an hour from the air."

Poisoning of Livestock resulting from the careless use of Agricultural Sprays

" Hazards to livestock are again occurring through carelessness in the application of sprays, now being extensively used to control pests and fungus diseases (unusually prevalent on account of the wet season) and to kill potato haulms," states a warning issued by the Ministry of Agriculture, Fisheries and Food.

" Special care should be taken when using copper-containing sprays for potato blight and arsenical preparations for killing potato haulms or weeds. The advice given by official sources, and supplied by manufacturers should be carefully followed. In particular it is essential (1) that access of stock to treated fields is prevented, (2) that spray drift and spillage does not contaminate fields other than those treated, and (3) that food and water for domestic animals and birds near spraying operations is protected from contamination," the Ministry's announcement adds.

Fluke Warning

There are already indications, associated with the unusually wet summer, that fluke disease may be prevalent in the autumn and winter. Scientific workers of the Ministry of Agriculture, Fisheries and Food would therefore like to warn farmers who have experienced trouble in past years to take special precautions, and to begin now.

Full information is given in Animal Health Leaflet No. 6 (obtainable from the Ministry's Divisional Offices) but it is urged that known "fluky places" should be treated now with bluestone to kill the snails which are now harbouring the infestation, to begin regular carbon tetrachloride treatment early, and to keep stock away from infested areas during the critical period of September to December. Advantage may be taken at this time of fields that were reserved for hay or that have carried a grain crop as these will be safe.

"Black disease" which is associated with fluke is also expected to be more prevalent and farmers are urged to see their veterinary practitioner about vaccination which is an entirely satisfactory means of prevention.

DIARY OF FORTHCOMING EVENTS

(*Hon. Secretaries are invited to send in details for inclusion in this column*)

2nd October.

" The Relationships of Root to Shoot Growth in Plants," a Joint Symposium of two sessions: organised by the Horticultural Education Association and the Association of Applied Biologists, Lecture Hall of the British Museum (Natural History) Cromwell Road, South Kensington, London, S.W. 7.

20th October.

Society of Chemical Industry, 14 Belgrave Square, London, S.W. 1. Dr. R. C. Fisher; " Development in timber insect control, 1927-58." Dr. W. P. K. Findlay; " Deterioration of wood fungi and its prevention by chemical treatment."

3rd-6th November.

British Weed Control Conference, 1958. Organised jointly by the Society of Chemical Industry and the British Weed Control Council, Hotel Metropole, Brighton.

NEWS OF THE INDUSTRY

A further increase in Group membership is noted in the annual Report of the Pesticides Group of the Society of Chemical Industry.

In December, 1957 this had risen to 312, compared with 287 for the previous year, and compared with 252 for December, 1954.

One symposium was held during the year and six other meetings—five in London and one jointly with the Aberdeen and North of Scotland Section, when Dr. R. A. E. Galley gave an address on "Pesticides—Problems and Prospects."

The summer visit was to the Cooper Technical Bureau and the Research Laboratories of Cooper, McDougall and Robertson.

A meeting on the "Biosynthesis of Phenolic Compounds in Plants" was held at Cambridge on 19th September, under the Chairmanship of Sir Robert Robinson, O.M., F.R.S., and included papers by:—Professor H. S. Mason, Dr. A. C. Neish, Dr. W. D. Ollis, Dr. H. W. Siegelman, Dr. Herschel Smith and Dr. W. B. Whalley.

The Minister of Agriculture, Fisheries and Food and the Secretary of State for Scotland, acting jointly, have made The Fowl Pest (Infected Areas Restrictions) Amendment Order, 1958. This amends the Fowl Pest (Infected Areas Restrictions) Order, 1956.

The Order, which came into force on the 8th September, 1958, permits the Ministry to license:—

(a) the movement of poultry into an Infected Area for immediate slaughter subject to safeguards designed to prevent the spread of infection; and

(b) the holding of sales of poultry on farm premises at the termination of a tenancy.

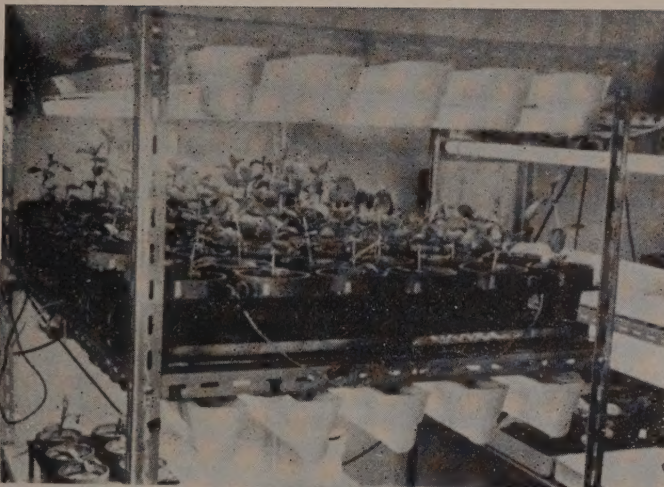
(Note—At the tme of writing, Infected Area Restrictions for fowl pest are at present in force in an area comprising the eastern part of Norfolk together with the petty sessional divisions in East Suffolk which adjoin the Norfolk border.)

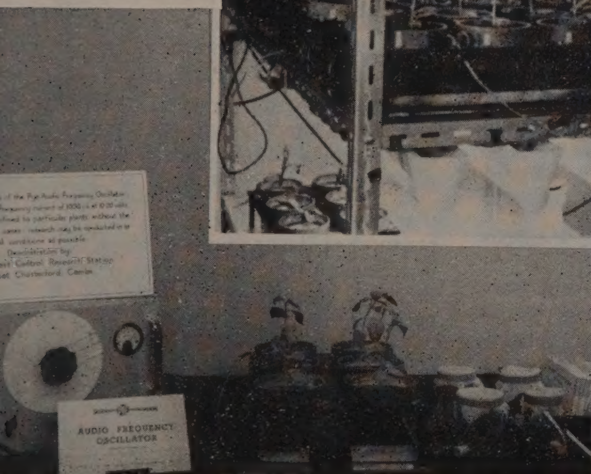
The Matthew Hall group of companies has issued a well produced, fully-illustrated booklet on "Fire Protection." The story of some of this group's sprinkler installations is well told by the series of photographs.

The Institute of Packaging, North-Western Area, is to hold a programme of educational courses for season 1958-9. Lectures are to be held at Liverpool and Manchester. On 4th February, Mr. C. Swinbank (Imperial Chemical Industries Ltd.), will discuss "Packaging in the Chemical Industry."

These courses organised by the Institute, are of particular interest, in view of the comment by Professor J. B. Cragg, M.Sc. (Chairman of Pest Infestation Research Board), in the annual report for the year ended 31st December, 1957, to the effect that there is an increasing demand for the development of insect-proof packaging materials.

"Serving the Oil and Chemical Industries" is the title of a booklet published by Metal Propellers Ltd.





(*above*) *A bank of plants with "confined" insects.*

(*left*) *PYE Audio Frequency Oscillator*

NEW PRODUCT

A factor in the maintenance cost of farm machinery is the necessity for keeping equipment in first-class operating condition.

The Allman Implement Washer and Spraying Unit has been designed for the cleaning of farm machinery and at a price of £35 5s. 0d. it offers an economical method. The unit incorporates the Rollervane pump which gives a working pressure of 200 lbs. p.s.i. and is equipped with a relief valve and return hose which enables surplus water to be returned to source.

The Allman Junior Washing Gun is supplied which permits the operator to have a pencil jet or a fine mist, or alternatively shut off the water entirely without any damage to the pump. The device also conserves water supply, a not unimportant factor.

The Allman Unit is so designed that it may be used for several other purposes other than cleansing, such as spraying, fire fighting and irrigation work. It will fit on to the power take-off of any tractor in a matter of moments.

Manufacturers are E. Allman and Co., Ltd., of Chichester.

" Fertiliser-Insecticide Mixtures " by R. C. Fitzgerald, Plant Manager, Smith-Douglass Co., Inc., Streator, Illinois, was the title of a paper given at the National Safety Council's headquarters in Chicago on 11th September.

The Midwest regional office of the National Plant Food Institute assisted in the arrangements.

Audio Frequency Oscillator

A "Guard Fence" for persuading insects to remain on plants, has been developed by W. G. Pye & Co. Ltd., of Cambridge. The apparatus consists of two concentric metal rings separated by an insulator and carrying an electric current supplied by Pye Oscillator. As an insect crosses from one ring to another it receives a shock of a certain frequency and voltage which discourages it from leaving the plant pot, but does not injure it. Fisons Pest Control Limited, at Chesterford Park Research Centre, Saffron Walden, Essex, have found, in their experiments with various types of insect control, that insects are sensitive not only to voltage but to frequency, hence the need for an oscillator capable of giving a good power output. They have discovered that the frequencies which are most effective lie within the audio range and are covered by the Pye Audio Frequency Oscillator.

For aphides the voltage which is needed is approximately 20v. and this is easily obtained from this oscillator, in fact, it is hoped that 144 separate rings can be supplied without any form of extra amplification. For controlling white caterpillars the voltage required is somewhat higher and a simple 10:1 stepping-up transformer increases the voltage accordingly.

The Allman Implement washer and spraying unit

BOOK REVIEWS

Advances in Pest Control Research

Volume 1.

Edited by R. L. Metcalf (Citrus Experimental Station, University of California, Riverside, California).

Published by Interscience Publishers Inc., 250 *Fifth Avenue, New York,* 1, *N.Y. For Great Britain and Northern Ireland: Interscience Publishers Ltd.,* 88-90 *Chancery Lane, London, W.C.2. Price* 11 *Dollars.*

It is obvious that in an industry so complex and expanding as the pesticides industry, anything which can assist the pest technologist to keep abreast of current developments is to be encouraged.

Interscience Publishers are to be congratulated in making available such a service, for that is what Volume 1 of " Advances in Pest Control Research " really is: a service for the pest technologist, whether he be engaged in laboratory work or in the field: a service which enables him, within 514 pages to have available 14 articles by leading contributors in their respective sections of the industry.

As the publishers observe on the jacket:—

" ' Pests ' can be anything from fungi to rodents, and the control of pests engages a number of sciences, from physiology to engineering. This series offers a medium for publication of reviews and critical evaluations in all branches of this complex field of applied science."

There has been published in the textile industry for many years now, a " Review of Textile Progress." Each year sees a further volume which brings up-to-date in printed form, developments in the industry, thus assisting materially the textile technologist. It is now one of the most sought-after works of its kind. We anticipate the same demand for this work by those engaged in pest technology.

Although the publishers of " Advances in Pest Control Research " give no indication of when further volumes may be expected, the writer presumes that not more often, and with a no greater gap, than twelve-monthly intervals. There is certainly enough happening on the technological side of the industry to justify a new volume each year in the writer's view. This is a growing industry and its many facets demand specialised treatment in such a way.

The contents of Volume 1 reflect the efforts of the Editor, Mr. R. L. Metcalf (Citrus Experimental Station, University of California, Riverside, California) who has done a remarkably good job. Enumerating these experts and their subjects, will give some indication of the worth of the publication: " Control of Health Hazards Associated with the Use of Pesticides " by J. M. Barnes (Toxicology Research Unit, Medical Research Laboratories, Woodmansterne Road, Carshalton, Surrey). " The Chemistry and Mode of Action of Herbicides " by A. S. Crafts (Department of Botany, University of California, Riverside, California). " Uses of Radioisotopes in Pesticide Research " by Paul A. Dahm (Department of Zoology and Entomology, Iowa State College, Ames, Iowa). " The Chemistry and Action of Organic Phosphorus Insecticides " by T. R. Fukuto (Department of Entomology, University of California, Riverside, California). " Mechanisms of Fungitoxicity " by James G. Horsfall (The Connecticut Agricultural Experiment Station, New Haven, Connecticut). " Recent Advances in Control of Soil Fungi " by J. B. Kendrick, Jr. and G. A. Zentmyer (both of Department of Plant Pathology, University of California, Riverside, California). " Repellents for Biting Anthropods " by G. F. Shambaugh, R. F. Brown and J. J. Pratt, Jr. (all from Entomology Section, Chemicals and Plastics Division, Army Quartermaster Research and Engineering Center, Natick, Massachusetts). " The Status of Systemic Insecticides in Pest Control Practices " by W. E. Ripper (Fisons Pest Control Limited, Bourn, Cambridge). " Chemical Analysis of Pesticide Residues " by Milton S. Schechter and Irwin Hornstein (both of United States Department of Agriculture, Agricultural Research Service, Entomology Research Division, Beltsville, Maryland). and " Bioassay of Pesticide Residues " by Yun-Pei Sun (Entomology Department, Agricultural Research Division, Shell Development Company, Denver, Colorado).

After each article there is a comprehensive list of references, in one case extending to over 450. The two lowest lists are 57 and 79. There is also a very good Subject Index.

It will be appreciated, therefore, that this first volume is exceedingly comprehensive and wide in scope and we have no hesitation in recommending this wholeheartedly to all pest technologists.

Mr. Metcalf, in his foreword, expresses the hope that " Advances in Pest Control " . . will become a " stimulating vehicle " for the fostering of new lines of research. He need have no fears.

Pest Infestation Research 1957, Department of Scientific and Industrial Research.

Published by H. M. Stationery Office, Price 5*s.* 0*d. net.*

Some annual reports make prosaic reading but an exception is that of Pest Infestation Research, Department of Scientific and Industrial Research. This annual report for 1957 is first-rate reading and even the non-qualified person will find much within the 55 pages to interest him. But for the pest technologist the significance of the work being done by Pest Infestation Research will be at once apparent and its importance cannot be rated too highly. Admirably illustrated, the contents range over the fields of biology, grain storage and microbiology, insecticides, fumigants, biochemistry and colonial liaison.

Not without significance is the section on Mode of Action of DDT. It is observed that DDT retains its status as one of the most important insecticides, yet its mode of action remains obscure. Work has therefore continued on this problem and further evidence has accumulated which indicates that DDT brings

about biochemical disturbances which do not appear to be indirect consequences of the excessive neuromuscular activity also induced.

References are made to "the extremely serious problem" of the development of resistance by insects to insecticides. This, it is considered should be given a high priority. It is good to note that the World Health Organisation has offered very substantial support to the Laboratory in aid of biochemical research on this project.

It is anticipated that the Laboratory will be fully and usefully occupied for many years to come on pest infestation problems in the United Kingdom.

The position in relation to the infestation of Britain's imported foodstuffs is considered "still fundamentally unsatisfactory."

The increasing demand for the development of insect-proof packaging materials is also stressed.

Bayer Agriculture Ltd.

Bayer Agriculture Ltd., of Thorneycroft House, Smith Square, London, S.W. 1, have issued an Information Folder which will prove most useful for the trade.

As new literature is published, copies may be inserted in the Folder, which is of a handy pocket size and has clip studs to hold the literature in position. Copies are obtainable on application.

Malastan Formations

A new leaflet describing Malastan formations of Malathion has been produced by The Standardised Disinfectant Co., Ltd., of 23 Sloane Street, London, S.W.1, and copies may be obtained on application.

Malathion has been described by the United States Department of Agriculture as "one of the safest insecticides to handle."

The Malastan range of high quality malathion formulations is listed and there is much technical information listed in this valuable new leaflet. There are also details given of the use of Malastan for public health.

The same company is to be congratulated on its go-ahead approach to overseas' markets. A brief history of the company together with its products and services, is contained in an attractive booklet which is published in several languages other than English, including French, Spanish and Portugese.

Annual Report

The Annual Report for 1957 of the Medical Officer of Health for Manchester (Dr. C. Metcalfe Brown, M.D., D.P.H., Barrister-at-Law), observes that "representations were made by the health department to the British Transport Commission (British Waterways) with regard to a further infestation of mosquitoes associated with a length of canal which is no longer navigable."

Mechanical methods of weed removal together with spraying by insecticides were undertaken by the Waterways Executive.

The Report also notes that three flour mills infested with flour pests and weevils were satisfactorily fumigated, two with hydrogen cyanide and one with methyl bromide by specialised fumigation contractors.

NEW PUBLICATIONS

200 Years Geigy. *Published by J. R. Geigy Ltd., Basle.*

"The name of Geigy is known throughout the world." Thus begins a fascinating account of the growth and development of the firm of Geigy, which this year celebrates its bi-centenary. Printed on excellent paper, in three languages (German, French, English) it contains admirable photographs on practically every page, many of them in colour, showing aspects of the company's activities.

It was in the 1930's that Geigy entered the field of plant protection, and as this souvenir publication observes:—

> "Several years of experimental work were to lay the foundations of a success which, in the event, came suddenly, almost overnight, and exceeded even the most sanguine hopes. Countless compounds had been tested. One of these, diphenyltrichlorethane, showed a slight contact action against insects. Yet the closely related dichlorodiphenyltrichloroethane, prepared from chloral and chlorobenzene, proved to be outstanding in that very respect. Paul Müller had discovered the insecticidal action of this compound. The discovery was something entirely new, something that others besides Geigy had been searching for; it was a turning point in the history of pest control."

Notes on Work Study. No. 3.

Published by the Association of British Chemical Manufacturers.
Cecil Chambers, 86 Strand, London, W.C.2. Price 3s. 3d. net. 4s. post free.

This publication, which contains case histories from smaller firms and individual plants in the chemical industry, includes one referring to increased output from batch process work. The plant described manufactures a liquid pesticide in the form of a mechanically produced dispersion of oil in an emulsifier.

Another case history described relates to the filling and packing of a liquid pesticide.

Thirty-Eighth Annual Report of the Forestry Commissioners for the year ended, 30th September, 1957.
Published by H.M. Stationery Office. Price 5s. 6d. net.

A very comprehensive report of the year's working of the Commissioners. Pest technologists will find the paragraph on Rabbits and Myxomatosis significant.

"There is no doubt that in spite of myxomatosis and the efforts of many owners and tenants of land, rabbits are on the increase and are on their way to re-infest areas over which they have been virtually exterminated," it is stated.
(*See News Item on page 19*).

Beneficial Insects. Bulletin No. 20. Fifth Edition.
B. D. Moreton, B.Sc., Agric. (Lond). Dip. Agric. (Wye), Dip. Ent. (Wye). (Advisory Entomologist, N.A.A.S., South - eastern province.) Published by H.M. Stationery Office, price 5s. 6d., net. 5s. 10d. by post.

Bearing an attractive red and black cover, this publication is well timed, bringing to our notice the many insects which form those important groups of beneficial insects to be found in this country—their life history, habits and the crops on which they are usually to be found searching for their particular prey. Detailed descriptions of these insects at all stages of their development are supplemented by many coloured illustrations which make it easier to recognise these benefactors.

The foreword by Mr. F. H. Jacob, Ministry of Agriculture, Fisheries and Food Plant Pathology Laboratory, Harpenden, is revealing, for he observes:— "We have, in fact, become increasingly aware of the important role of many inconspicuous insect parasites and predators, previously thought to be of little more than academic interest. To a considerable extent this has followed advances in the use and development of insecticides, and the Fruit Tree Red Spider mite is perhaps the classic example of an insect that did not become of major importance until the introduction of a new insecticide. It is known that this was due to the elimination of the mite's predators by the insecticide."

There are 49 pp. including bibliography and 4 pp. of coloured plates.

The Pesticide Problem.
Prepared for the Conservation Foundation and The New York Zoological Society by John L. George (Associate Curator of Mammals, New York Zoological Park).

Described as "A brief review of present knowledge and suggestions for action," the publication deals with the American scene and problems confronting that country. The problems are not necessarily those of this country. It is well worth reading, however, and there is a very good bibliography and a classification of pesticides and annotated list of pesticides commonly used.

Record of the 1957 Annual Convention of the British Wood Preserving Association.
Issued by the British Wood Preserving Association, 6 Southampton Place, London, W.C.1.

Well printed and produced, this is the complete record of the convention for the technologist's bookshelf.

Pest Infestation Research 1957 Department of Scientific and Industrial Research.
Published by H.M. Stationery Office, 1958. Price 5s. net.

A fascinating document which commands a place on the bookshelf of all those engaged in the industry. There are eight pages of excellent photographs. (*See Review on page 30.*)

Australia. Report on the Market for Pesticides.
Published by Export Services Branch, Special Register Information Service, Board of Trade, Lacon House, Theobalds Road, London, W.C.1.

The report deals with the market in Australia for pesticides generally for use on stock, produce of the soil and for domestic protection. It is emphasised that the U.K. is more likely to do business in supplying formulae and ingredients to formulators than in the sale of formulated products.

Annual Report for 1957 of the Medical Officer of Health for Bolton (Dr. Ronald W. Elliott).

This annual report reveals progressive thinking by the local authority concerned in the subject of infestation of imported food products as well as other aspects of pest control.